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Land Sales and Rental Markets in Transition

Evidence from Rural Vietnam

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Abstract

The extent to which households should be allowed to transfer their land rights in post-socialist transition economies is of considerable policy interest. Deininger and Jin use data from Vietnam, a transition country that allows rental and sales of land use rights, to identify factors conducive to the development of land markets and to assess the extent to which land transfers enhance productive efficiency and transfer land to the poor. They find that activity in both rental *and* sales markets has increased rapidly, enhanced by the possession of long-term use rights and off-farm employment, and contributing to greater equity and efficiency of land use. While there is evidence for distress sales by households that experience a shock (death), the scope for such sales is reduced by well-functioning credit markets. Well-defined land rights and appropriate safety nets will thus help transition economies to realize the benefits from the operation of land markets.

This paper—a product of Rural Development, Development Research Group—is part of a larger effort in the group to assess the impact of land policy on equity and productive development. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Maria Fernandez, room MC3-542, telephone 202-473-3766, fax 202-522-1151, email address mfernandez2@worldbank.org. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. Klaus Deininger may be contacted at kdeininger@worldbank.org. April 2003. (30 pages)

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Land Sales and Rental Markets in Transition: Evidence from Rural Vietnam

1. Introduction

During the last decade, countries whose rural sector had been collectivized have made considerable progress towards establishing private property rights and restructuring of agricultural production. Even before the collapse of the Soviet Union and the large-scale, though uneven, move towards individual property rights that is described elsewhere (Csaki *et al.* 2002), China has, in 1978, established the Household Responsibility System, leading to a large surge in agricultural production (Lin 1992) and other Asian countries such as Vietnam, Laos, and Cambodia, have abandoned collectivization and moved towards formulation of new land laws. Problems associated with collective farming also led to the disappearance of collectives in other countries such as Ethiopia, Mozambique, and Nicaragua, three countries that made the transition towards individual land rights in the 1990s (Nega 2002, Tanner 2002, Deininger and Chamorro 2003), similar to a considerable strengthening of private land use rights adopted elsewhere, e.g. in the context of Mexico's 1992 Constitutional Reforms (World Bank 2002).

However, although all of these reforms have improved individuals' authority over land use, the extent to which land can be transferred, either through rentals or sales, varies considerably. In fact, many transition countries have imposed restrictions on the ability to effect land transfers out of fear that these may have negative impacts on either efficiency or equity. Whether or not such restrictions are appropriate is subject to considerable debate; some researchers have cautioned against premature liberalization of land markets (Lastarria-Cornhiel 1997, Platteau 1996) or even to warn about outright negative consequences of doing so (Manji 2003). Available empirical evidence to support judgments remains thin, characterized by two main shortcomings.

On the one hand, there is often little distinction between the two types of land transfers. This is of relevance as one would expect land rental and sales markets to respond to market imperfections in rural areas of developing countries in very different ways. It is well known that, in the presence of imperfections in more than one market, enabling households to freely engage in land market transactions

may not contribute to greater productivity but instead lead to re-concentration of land. The relatively thin evidence available, e.g. from Chile (Echenique and Rolando 1990) and Honduras (Carter and Salgado 2001) seems to confirm this although examples from Paraguay (Carter and Galeano 1995) and Guatemala (Barham *et al.* 1995) suggest that well-functioning land markets may, in some situations, also transfer land to small producers. However, most of the available empirical evidence originates from Latin America, a continent that is characterized by high inequality in access to land, a long history of distortions in agricultural markets, a tradition of weak property rights, and often significant entry barriers in the rural non-farm sector (Reardon *et al.* 2001). Many of these conditions differ markedly from East Asia and in some cases also Africa where, with some exceptions, land ownership is more egalitarian, population density is often high, and with lower wages and higher rates of economic growth, opportunities to join the off-farm sector are more plentiful.[1]

There is general agreement that expansion of the off-farm economy implies not only greater demands for land markets but can also be affected by the scope for such markets to function (de Janvry *et al.* 2001), empirical analysis of the factors underlying the performance of land sales and rental markets as well as their impact would be of considerable interest. Two key elements would be the extent to which markets contribute to equity, i.e. provide land access to the poor, their contribution to greater productive efficiency, and the existence of potential trade-offs between these two goals. Concerning productivity of land use, data limitations have in the past often prevented studies from making clear inferences.

In view of the fact that with development of the off-farm economy, the scope for productivity-enhancing land transfers, and thus the losses associated with administrative prohibition or malfunctioning of such markets, are likely to increase significantly, the lack of empirical evidence on the level of activity and productivity impact of land markets is of great policy relevance. In this paper, we address both of these issues by providing evidence on the functioning of land rental and sales markets separately and by using a measure of households' productive efficiency for the case of Vietnam, one of the few transition countries where, even though land ownership remains with the state, both short term rental and permanent transfers of use rights are allowed. Conceptually, and in line with the literature, we assume that land markets are driven by three factors, households' agricultural ability which is unobserved; labor market imperfections in the form of supervision constraints; and capital market imperfections. (Deininger *et al.* 2002). Empirically, a large and nationally representative panel data set is used to illustrate the evolution of markets over time and derive a proper measure of producers' ability that can be used to make inferences on the productivity impact of land markets.

[1] Many of these characteristics also apply to the African countries mentioned earlier, although population density is of course very low in Mozambique, in contrast to Ethiopia.

The paper is structured as follows: Section two provides background on Vietnamese land policy, the conceptual framework and the econometric approach. Section three describes the data used and summary statistics on socio-economic characteristics and land market participation by sample households. Section four discusses the econometric evidence on demand and supply of land in sales and rental markets, respectively. Section five concludes.

2. Background and conceptual framework

We set the scene by describing recent land policy initiatives in Vietnam and, based on a general discussion of land and other factor markets in developing countries, present the conceptual model and the estimation strategy underlying our empirical analysis. Conceptually, we note that imperfections in labor and capital markets can give rise to sub-optimal outcomes in land markets and discuss some of the empirical evidence with respect to land rental and sales markets, respectively. The conceptual model identifies ability, off-farm development, and government policies as key elements affecting functioning of rental markets and discusses how initial wealth, incidence of shocks, and access to credit will modify these in the case of land sales markets so as to derive empirically testable hypotheses.

2.1 Land policy in Vietnam

From 1981, Vietnam started to transform its rural sector from collectivized agricultural production to a system based on households' initiative, a move that culminated in the passage of the 1988 Land Law (World Bank 2000). Studies have shown that this led to significant increases in overall rural productivity, although pre-existing differences between North and South were not eliminated (Pingali and Xuan 1992, Tran 1998). After 1988, further policy reforms were initiated to increase security of land use rights and liberalize inputs and outputs markets. A new law was enacted in July 1993 to deal with factors such as threats of administrative reallocation, short duration of use rights, lack of transferability and the inability to use land as collateral, all of which were perceived to discourage investment and preclude further development of land markets. This law establishes the right to inherit, transfer, sell, lease or mortgage land use (though not ownership) rights and to receive compensation in case of expropriation. The new law also extended the duration of land use rights to 20 years for annual 50 years for perennial crops. All of these reforms together have greatly increased the transferability of land rights, providing a near-ideal case to compare in practice the functioning of sales and rental markets.

The literature suggests that these reforms have not only increased efficiency but also had considerable equity benefits (Ravallion and van de Walle 2001). Higher levels of issuance of land-use certificates to indicate more secure land rights have been found to be associated, at the community level, with higher levels in the share of total area devoted to perennials and some increase in irrigation investment (Do and

Iyer 2002).[2] It has helped Vietnam to achieve tremendous increases in output and to not only transform itself from a net importer of rice to the world's second largest exporter (Tran 1998) but also to increase its share in a number of agricultural export markets, making it one of the fastest growing economies in the world during the 1990s. With a fairly egalitarian land distribution such growth was translated into broad poverty reduction; the poverty headcount dropped from 58% in 1992-1993 to 37% in 1997-1998 (Phong and Glewwe 2002).

2.2 Land and other factor markets in rural areas of developing countries

To motivate the separate treatment of land sales and rental markets, we discuss key imperfections in labor and capital markets that affect the behavior of such markets. We note that, as a result of high risk, imperfect markets for credit and insurance, limited ability to use land as a collateral to obtain credit financing, and non-agricultural demand for land, agricultural sales markets may indeed encourage transfer of land towards uses that may not always be socially optimal. At the same time, even in situations where this is the case, informal exchange or formal land rental can do much to facilitate temporary land transfers that can significantly increase productive efficiency and equity. Temporary, possibly informal, exchanges of land offer greater flexibility but are also less affected by market imperfections than sales markets. Land transfers, between producers and across generations, are likely to become of greater importance as, with development of the rural economy, greater opportunities for off-farm employment emerge, a conjecture supported by the important role of land rental in many developing as well as developed countries (de Janvry *et al.* 2001).

In fact, in a world of perfect information and complete markets, with zero transaction costs and constant returns to scale for agricultural production, the ownership distribution of land ownership will affect households' welfare but will not matter for efficiency outcomes, as all producers will adjust to operate an "optimum" farm size through temporary transactions in land or labor markets (Feder 1985). Imperfections in rural *labor* markets are mainly due to the cost of supervision which arises from the fact that, except in very limited circumstances, a wage workers' true effort is not easily observable. This implies that wage workers will have limited incentives to exert effort and either need to be supervised at a cost[3] or be offered contracts that provide higher incentives. Family members have higher incentives to provide effort than hired labor, implying that it would be advantageous for those who do not have enough land to fully utilize their family labor endowment to rent in land or for those who are relatively land abundant to rent out, rather than engaging in labor market transactions that incur supervision costs. A number of studies have confirmed a negative farm-size productivity relationship for all but the smallest farm size classes

[2] Reform of property rights and incentives has been credited with a key role in overall growth not only in a static but also a dynamic sense (Che *et al.* 2001).

[3] In agricultural production, supervision is particularly difficult or costly due to the spatial dispersion of the production process and the vagaries of nature imply a need to constantly adjust to micro-variations of the natural environment.

(Berry and Cline 1979, Carter 1984, Newell *et al.* 1997, Kutcher and Scandizzo 1981, Burgess 2001, Udry 1997), or have not been able to reject the hypothesis of constant returns to scale in agricultural production (Lanjouw 1995, Feder and et al. 1992, Wan and Cheng 2001, Olinto 1995). Labor market imperfections would tend to transfer land from large producers who would have to rely on wage labor to "poor but efficient" small producers whose family labor is not fully utilized by cultivating their endowment. Differences across households in (unobservable) agricultural ability would add an additional dimension but not alter the basic relationship.

Credit market imperfections can, however, offset or even eliminate supervision cost advantages of family farmers. For example, if there is a need for up-front working capital (e.g. to acquire inputs in addition to land and labor) and credit markets do not function well so that access to capital depends on initial wealth, the optimal size of the operational land holding would vary systematically with the size of land owned even if land rental markets were to operate perfectly. This will give rise to a positive relationship between farm size and productivity, as is indeed confirmed by studies from environments where credit markets are important, e.g. Sudan (Kevane 1996) or in Malawi (Dorward 1999).

The relative importance of credit market imperfections varies, however, systematically between rental and sales markets. In rental markets, share contracts provide scope for overcoming capital market imperfections at relatively low cost (Basu 1992, Otsuka *et al.* 1992, Ghatak and Pandey 2000, Ray and Singh 2001) and the prevalence of share contracts in many regions around the world provides evidence that the circumstances under which it is a second best solution are rather common. In fact, systematic variation of contract parameters depending on tenants' wealth provides empirical confirmation for this (Quibria and Rashid 1986, Shetty 1988, Shaban 1991, Laffont and Matoussi 1995). Many studies support the hypothesis that share tenancy provides a second best arrangement which, in any given environment, is difficult to improve upon unless overall circumstances change so that the operation of factor and credit markets improves (Otsuka *et al.* 1992, Sharma and Dreze 1996, Sadoulet *et al.* 1994, Lansink *et al.* 2002, Quisumbing 2001, Otsuka 2002). We therefore hypothesize that, while credit market imperfections will affect the nature of contracts adopted, it will not undermine the tendency of rental markets to transfer land to more productive producers.

Contrary to rental markets, sales market outcomes will be affected by credit market imperfections and other factors in a number of ways. First, where agricultural production is very risky and insurance is not available, farmers may be forced to sell land off at low prices in distress sales (Cain 1981, Bidinger *et al.* 1991, Kranton and Swamy 1999). Covariance of land prices may imply that they will be unable to replenish their asset portfolio later (Zimmerman and Carter 1999, Binswanger *et al.* 1995). Also, to the extent that land is valued as an asset, in addition to its use as an input into agricultural production, non-agricultural land demand, (tax and subsidy) policies, and macro-economic conditions can increase land

values over and above the present value of profits from agricultural production for specific groups but not for others (Robison *et al.* 1985, Brandao and Rezende 1992, Gunjal *et al.* 1996), making it more difficult for productive farmers to acquire land. Lack of long-term credit can further exacerbate the ability of small and productive farmers to acquire land through the sales market. Land sales markets would be even more constrained from transferring land to producers based solely on considerations of productivity in cases where absence of long-term finance makes it more difficult for the latter to finance such acquisition. All of this leads us to expect that rental markets will be more able than sales markets to transfer land to more productive producers. We therefore expect sales and rental markets to have quite different outcomes, although the extent to which more productive producers will have access to greater amounts of land and to which credit market imperfections will affect market outcomes remains an empirical question.

2.3 Conceptual model

To formalize this, we first consider land rental markets and then add some of the additional factors that have to be taken into account for land sales. Let household *i* be endowed with fixed amounts of labor ($\overline{L}_i$) and land ($\overline{A}_i$), and a given level of agricultural ability (α_i). Relative land abundance is assumed to make farming based on hired labor infeasible and households can allocate their labor endowment between farming their own land and off-farm employment at an exogenous wage (w_i). Renting incurs transaction costs (T) proportional to the amount of land transferred and we assume that working capital is not binding. With this, household *i* will choose l^{a*}, l^{o*} as well as A^* by solving the maximization problem:

$$\underset{l^a, A}{Max}\; pa_i f(l_i^a, A_i) + wl_i^o - I^{in}(A_i - \overline{A}_i)(r+T) + I^{out}(\overline{A} - A_i)(r-T) \qquad \text{(P)}$$

where p is the price of agricultural goods, l^o is the amount of time allocated to off-farm labor ($=\overline{L}_i - l_i^a$), I^{in} is an indicator for rent-in (=1 for rent-in, and 0 otherwise), similarly I^{out} is an indicator for rent-out (=1 for rent-out, and 0 otherwise), and all other variables in (a) are as defined above. The optimal choices of l_i^{a*}, l_i^{o*} and A_i^* will solve the first order conditions (FOC) of problem (P), i.e.

$$p\alpha_i f_{l_i^a}(l_i^a, A_i) = w \qquad (1)$$

plus, for households who rent in, $$p\alpha_i f_{A_i}(l_i^a, A_i) = r + T \qquad (2)$$

or for households who rent out, $$p\alpha_i f_{A_i}(l_i^a, A_i) = r - T \qquad (2)'$$

and for autarkic households, $$r - T < p\alpha_i f_{A_i}(l_i^a, A_i) < r + T \qquad (2)''$$

The first order conditions allow to derive three empirically testable propositions (see the appendix for a more detailed derivation) as follows:

Proposition 1. The amount of land rented in is strictly increasing in ability, α, and strictly decreasing in their land endowment $\overline{A}$. Rental markets will thus transfer land to "poor but efficient" producers.

Proposition 2. Transaction costs drive a wedge between those renting in and those renting out with any increase in T decreasing α_l and increasing α_u, thereby expanding the range of producers who remain in autarky, reducing the number of households who participate in rental markets, as well as the amount of land transacted through rental markets. Reduction in transaction cost will increase social welfare.

Proposition 3. Increases of the wage for off-farm employment will increase the amount of land transacted in rental markets and overall welfare. This will be associated with a decrease in the equilibrium rental rate and, in a risk-free environment, will make everybody better off.

As discussed in more detail below, we use an estimate of producers' agricultural ability to test proposition one; the level to which long-term and secure land rights are available at the community level, for proposition two; and the level of off-farm development at the village level as well as households' non-farm employment history for proposition three.

For land sales markets, we follow the literature on inter-temporal asset accumulation which implies that household *i's* choice of consumption, land accumulation and saving each period together solve life time utility maximization:

$$\text{Max} \qquad V = E_t \sum_{k=0}^{T-t} (1+\delta)^{-k} U(c_{t+k}) \tag{3}$$

$$\text{Subject to} \qquad c_{t+k} + (\overline{A}_{t+k} - \overline{A}_{t+k-1}) p_{t+k} + (S_{t+k} - S_{t+k-1}) \le Y_{t+k}(\overline{A}_{t+k}) \tag{3a}$$

$$\text{and} \qquad \overline{A}_{t+k} \ge 0 \tag{3b}$$

where $U(c_t)$ is one period utility function, c_t is the level of consumption, δ is the rate of time preference, $\overline{A}_t$ is amount of land owned in time t, S_t is amount of saving in time t, $Y_t(\overline{A}_t)$ is the amount of income household i generate in time t which itself is a function of the land household i owns in that period (assume household self-cultivates all the land endowment). (3b) is a form of borrowing constraints, restricting the end stock of tradable assets to be nonnegative in each period.

If income is stochastic, an analytical solution to this problem can not be derived (Zeldes 1989) and the literature has resorted to simulation to obtain solutions under general assumptions (Deaton 1991, Zeldes 1989, Rosenzweig and Wolpin 1993, Carter and Zimmerman 2000). We note that if land rights are secure

in the long term and (long-term) rental as well as credit markets function well (allowing, in particular, the use of future rental income as a collateral), no land sales markets would be needed as all the outcomes from such markets could be accomplished by long-term rentals. With secure land rights but credit market imperfections, the only reason to sell land would be as response to a shock that threatens to push consumption below the minimum needed for survival. We would therefore predict that land sales, as compared to rentals, would be undertaken only by households who experienced critical shocks and who are unable to borrow against their land because the financial infrastructure is incomplete. Purchase of land will, in such an environment, require higher levels of wealth or access to credit markets. Thus, whether or not a household experience shocks, as well as credit market access and initial wealth are thus variables that are unlikely to affect rental markets but would be predicted to have a significant impact on land sales and purchases.

2.4 Estimation strategy

To obtain an estimate of households' agricultural ability, we use the fact that we have a panel of households to estimate a production function with household fixed effects. Let technology be represented by the Cobb-Douglas production function

$$Q_{ijt} = \exp(\alpha_j + \alpha_j) A_{ijt}^{\theta_1} L_{ijt}^{\theta_2} K_{ijt}^{\theta_3} \qquad (4)$$

where Q_{ijt} is agricultural output produced by household i in village j in year t; A_{ijt}, L_{ijt} and K_{ijt} are the land, labor and capital used to produce this output Q, with technical coefficients θ_1, θ_2, and θ_3, and $exp(\alpha_i+\alpha_j)$, is the efficiency parameter which consists of a household-and a village-specific element reflecting access to infrastructure and markets, soil quality, climate, etc. Taking logs of both sides of equation (1) and adding a time trend and an *iid* error term, and letting $\alpha_{ij} = \alpha_i + \alpha_j$, we obtain an estimable equation for production by household i in village j at time t as follows.

$$q_{ijt} = \alpha_{ij} + \theta_1 a_{ijt} + \theta_2 l_{ijt} + \theta_3 k_{ijt} + \phi t + \varepsilon_{ijt} \qquad (5)$$

where lower case letters refer to the logarithm of the quantities referred to above. Availability of multiple observations per household in the panel allows us to estimate this equation using household fixed effects.

$$q_{ijt} - \bar{q}_{ij} = \alpha_{ij} - \bar{\alpha}_{ij} + \theta(Z_{ijt} - \bar{Z}_{ij}) + \phi(t - \bar{t}) + \varepsilon_{ijt} - \bar{\varepsilon}_{ij} \qquad (6)$$

where Z_{ijt} is a vector consisting of a, l, k and θ is a coefficient vector. In addition to land[4] and household composition to proxy for labor use,[5] Z_{ijt} includes chemical fertilizer, organic manure, pesticides, and seeds. Fixed capital is the value of all assets related to crop production. As no values were given for draft

[4] To control for land quality, we include the share of irrigated land in total crop land in the regression.
[5] Unfortunately, the survey does not provide detailed information on labor use in agricultural production, forcing us to use family composition instead.

animals, we include a dummy indicating whether the household owned a draft animal or not. Estimation of equation (6) allows us to recover the composite efficiency parameter α_{ij}. As this variable still includes unobservable characteristics at the village level, we apply a similar procedure at the village level to obtain α_j the subtraction of which from α_{ij} provides an estimate ofα_i, the pure idiosyncratic effect for each producer in the sample.

As discussed earlier, a household's decision to enter land rental markets depends on its agricultural ability, the size of its land endowment, the off-farm opportunities available, and the size of transaction costs associated with market participation. Given that the incidence of land market activity in 1993 was still very limited, and not all of the right hand side variables were available for the first period, we estimate rental and sales market participation for the 1998 cross section. Formally we estimate the following equation for rental market participation using probit and tobit models for either a participation dummy or area rented

$$R_i = \beta_0 + \beta_1 \alpha_i + \beta_2 A_i + \beta_3 X_i + \beta_4 O_i + \beta_5 C_i + \beta_6 T_i + \beta_7 S_i + \varepsilon_i \qquad (7)$$

where R_i is a dummy for participation in rental or markets or the area rented in or out, respectively, α_i is agricultural ability, derived as described above, A_i is the household's per capita land endowment, X_i is a vector of household characteristics including age, sex, the head's education, other asset endowments, and initial per capita expenditure to proxy for poverty. Two other household-specific vectors or variables, O_i and S_i, indicate whether the household had past off-farm or migration experience and the level of local off-farm development (O_i) and whether the household experienced one or more shocks in the 5-year period preceding the survey (S_i). Finally, T_i denotes the share of producers (excluding the one under concern) who have been awarded written long-term use rights to proxy for lower transaction costs of land market participation. To approximate the ability to access credit markets, C_i indicates the share of other producers in the village who reported having access to formal credit, a measure that is similarly constructed as T_i.

The prediction that land (rental) markets would transfer land to more productive producers with lower endowments (proposition one) leads us to expect that $\beta_1 > 0$ and $\beta_2 < 0$ in the equation for renting in and opposite signs in the equation for renting out. While a positive or negative sign for renting in or out, respectively, on the element of β_3 corresponding to agricultural assets would point towards imperfections in markets for these assets, the sign on other assets in the rental equation is indeterminate a priori. From proposition two, we expect that β_6 be positive both in the renting in and the renting out equations, i.e. that better definition of property rights over land will increase both supply to rental markets and demand for such transfers. At the same time, we expect β_7, the coefficient on whether or not a household experienced a shock, to be insignificant and do not have a strong prior regarding credit access. Based on proposition

three, we expect households whose past experience in off-farm labor markets reflects greater opportunities for such employment to be less likely to rent in and more likely to rent out and the level of rental market activity in general to increase with development of the off-farm economy in a community as measured by the share of income derived from non-agricultural sources.

The equation to be estimated for participation in land sales markets is similar, with the only difference being that the dependent variable now refers to land purchases during the 5-year period preceding the survey and that a number of the dependent variables refer to initial conditions rather than, as in the case of rental markets, contemporaneous ones. Formally, we estimate

$$P_i = \beta_0 + \beta_1 \alpha_i + \beta_2 A_i + \beta_3 X_i + \beta_4 O_i + \beta_5 C_i + \beta_6 T_i + \beta_7 S_i + \beta_8 S_i C_i + \varepsilon_i \qquad (7)$$

where P_i is a dummy for participation in sale or purchase markets or the area involved, respectively, α_i is agricultural ability, A_i is the household's initial (1993) per capita land endowment, X_i is a vector of initial household characteristics including age, sex, the head's education, initial asset endowment, and initial consumption. The remaining variables, O_i, S_i, T_i and C_i are defined as above and the only difference is that we add a interaction between S_i and C_i. The rationale for doing so is that, as discussed above, in environments where credit markets do not function well, distress sales could be a main source of supply of land to the sales market, something that can be tested by including this interaction.

Recall from our earlier discussion that we expect that initial wealth is more important as a determinant of land purchases than rentals. Second, even though we would expect households' ability to increase their demand for cultivable land, the variable would be less important in sales markets. Thus, although we would still expect $\beta_1 > 0$ and $\beta_2 < 0$ in the purchase equation and opposite in the sales equation, the magnitude and significance of the coefficients is expected to be lower in the latter where we also expect agricultural assets to be of greater importance. In addition to continuing importance of both transaction costs and off-farm labor market opportunities, we also expect that permanent land transactions both credit market access and having experienced a shocks in the past will be important. With presence of financing constraints, we expect availability of credit to increase households' propensity to purchase land. At the same time shocks, especially in environments where credit markets are thin, may force households to undertake distress sales, thus having a positive impact on land sales but not on land purchases.

3. Data sources and descriptive evidence

Before discussing econometric results, we highlight some salient features of Vietnam's rural economy by presenting evidence on socio-economic characteristics and changes in land market participation over time. The data illustrate the considerable reduction of poverty achieved through high levels of recent economic growth and off-farm development but also a point towards considerable, though regionally differentiated, increase in land market activity.

3.1. Socio-economic characteristics

The data used in the analysis come from the 1992/93 and 1998 rounds of Vietnam's Living Standards Surveys (VLSS) which included 4,800 and 6,000 households, respectively. The survey was conducted by Vietnam's General Statistical Office and the sample stratified into 7 administrative areas which we group into four major regions. Our analysis focuses on the 2825 households included in the rural panel of the VLSS who were interviewed in both 1992/3 and 1998. Table 1 reports descriptive statistics for the whole country in 1993 and 1998 and the four main regions in 1998.[6] We note that the size of an average household ranged from 4 to 5 persons, about 3 in the 14 to 60 age category and 0.5 above 60, and the age of household heads about 44 in 1993. About 20% of households, ranging from 17% to 30% depending on the region, were headed by a female. Levels of formal education increased considerably, from 4 years in 1993 to 6.8 years in 1998. About 10% of households experienced loss of one or more adult family members during the 1993 to 1997 period.[7]

Survey results point towards an average annual increase of per capita expenditure of 5.9% over the 1993-1998 period, from 1.69 Mn. Dong to 2.26 Mn. Dong. While per capita income in 1998 is almost equal to per capita expenditure, the large gap between the two in 1993 is likely to be attributable to measurement error, i.e. underreporting of income in the first period. Despite this increase, and a highly egalitarian distribution of per capita expenditure, which is characterized by a Gini coefficient of 0.26, the rural economy is still quite poor, with per capita income amounting to between US$153.46 (in the Northern Uplands) to US$ 245.45 (in the South).

The rapid pace of off-farm development is illustrated by the marked increase in migration visible in table 1. While the share of household heads who had migration experience increased from 11% in 1993 to 15% in 1998, the next generation seems to have benefited most from the increase in off-farm employment. The share of households who had at least one member with an off-farm job increased from 30% to 55% between the two periods and the incidence of migration by household members accelerated from 29% in 1993 to 64% in 1998. The level of migration differs across regions, with only 56% of households having a migrating member in the Red River Delta and North Central, as compared to 75% in the Southeast and Mekong Delta. However, the increase in the share of households who, since 1993, have had at least one member migrate was fairly uniform across the four regions, implying that the variation observed is due to pre-existing differences rather than a differential evolution (and a failure of some regions to benefit from off-farm employment).

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[6] In the descriptive table and also for all the econometric regressions, we divide the 2824 households into 4 regions based on the original 7 administrative regions. Region1 include the 546 households from Northern Uplands administrative region. Region 2 includes the 1326 households from Red River Delta and North Central. Region 3 includes the 298 households from original Central Coast region. Finally Region 4 includes the 650 households from Southeast region and Mekong River Delta region.

[7] We focus on adults, defined as being above the age of 13 years, because in these cases, deaths imply the loss of a significant amount of family labor, the need to incur expenses for burials, and possibly also the necessity of distributing land holdings among heirs. Any of these will seriously reduce the household's productive capacity.

The high level of non-farm activity notwithstanding, agriculture and crop production remain the main sources of income for rural households even though their share has decreased from 83% to 78% or 70% to 66% for agricultural and crop income, respectively. This implies that the level of endowments, as well as the scope for exchanging land endowments through formal and informal means, continue to be of great importance for overall livelihood. In this context, we note that per capita land endowments remain small (0.3 ha of annual and 0.06 ha of perennial crops on average), though somewhat variable across regions. They are largest in the South where the per capita endowment is more than 1 ha (0.85 ha of annuals and 0,23 ha of perennials) and smallest in the Red River Delta (0.26 ha of annuals and 0.02 ha of perennials). We also note that land was quite equitably distributed, with a Gini coefficient of per capita land endowments ranging between 0.34 to 0.37 except for Southeast & Mekong Delta where the Gini coefficient is 0.51 as compared to 0.26 for per capita expenditure. At the same time, we note that there was no significant increase in land inequality during the period under concern; in fact the Gini coefficient for per capita land endowments is estimated to have declined slightly, from 0.53 to 0.50.

Table 1 also highlights that there has been a large increase in the share of land held under long-term use rights, a share that increased from 25% in 1993 to 88% in 1998. Given that in all the regions except the South (where 65% of land were held under long-term rights in 1993), the share of land held under long term use rights was one fifth or less of the total, this points towards a considerable administrative effort at documenting and increasing the security of land rights.[8] The inter-regional variation in broad levels of development noted earlier is reflected in differences of overall asset endowments, computed as the sum of housing, enterprise, and business assets (agricultural and non-agricultural but excluding land). In line with what is observed in many developing countries, housing constitutes rural households' main asset while enterprise asset make up only between 6% and 13% of the total. Asset endowments are highest in the South. Our data also indicate that access to formal credit remains limited; while the share of producers reporting to have had access to such credit increased from 9% to 21% between 1993 and 1998, being above one third of the total in the South and Central Coast but relatively low in other regions.[9]

3.2 Land market participation

Descriptive evidence on land market participation in both periods as reported in Table 2 points towards a rapid increase in land transactions, together with considerable differences across regions. Rental market participation more than quadrupled from 3.8% in 1993 to 15.8% in 1998. Interestingly, within rental markets, the lion's share of land, almost half in each period, is obtained for free (1.7% in 1993 and 7.2% in 1998), followed by fixed rent (1.7% and 6.2%, respectively) and sharecropping arrangements (0.4%

[8] Although the region-wise, about 88 percent of annual land are entitled with long-term use, but village-wise, some 20 percent villages (21 out of 220) only have less than 60 percent of annual land within village are entitled with long-term land use.
[9] Note that in the regressions reported below we use the share of households in a given village (excluding the household under concern) who have access to credit as the right hand side variable to avoid endogeneity.

and 2.4%). While the share of households who report to have transferred out land is, with 0.8% in 1993 and 5.8% in 1998, much lower, probably due to the fact that some of the absentee landlords are not accounted for, it illustrates a similarly strong increase in overall rental market activity.

The increase in land sales transactions was even more pronounced, from a mere 1% of producers who bought land in the 5-year period prior to the survey in 1993 to 7.2% (equivalent to an annual turnover of almost 1.5%) in 1998. Descriptive data also point towards marked differences, both in overall participation and in the relative weight of different modalities of land transfer, across regions. Even though rental is quantitatively more important than sales everywhere, the share of producers who purchased land is high in the Northern Uplands and the South and Mekong Delta, although purchases are virtually non-existent in the Central Coast. Also, in all cases, fixed rent is more important than share cropping but in all regions except the Central Coast and the South, free informal transfers of land are more important than cash rental. Clearly, econometric analysis of the factors underlying these outcomes, as well as their likely impact, will be of great interest.

4. Econometric evidence

We report results from rental and sales equations separately and refer to the appendix for production function estimation used to derive households' agricultural ability. The key finding is that demand for renting in and purchase is driven by higher levels of productivity and lower land endowments. At the same time, and as predicted, more secure land rights reduce transaction costs and help activate rental and sales markets. Access to credit and asset endowments are important mainly for land purchases but not for renting in. Regarding supply to rental markets, off-farm experience and non-agricultural assets emerge as key variables in the renting out equation where the land endowment is of marginal significance and ability is insignificant. In the sales equation, land endowments and productivity are significant and of the predicted sign. Furthermore, we find that being affected by a shock, and credit access, has a significant impact on land sales markets.

4.1. Land rental markets

Table 3 presents results for rental market participation, both on the demand and the supply side. The positive and statistically significant coefficients of agricultural ability in the basic models of rent-in participation equation (columns 1 and 3 of table 3) indicates that rentals transfer land to households with high level of agricultural ability. To illustrate, the most efficient producer in the sample (α=3.28) has a more than 20% higher probability of obtaining additional land through rental than the least efficient (α=-2.29), other things constant. This suggests that, as expected, land rental markets indeed transfer resources to those producers who are able to make more productive use of them.

In addition to the positive impact on efficiency, we also note that land rental markets have a positive impact on equity by transferring land to those with more limited endowments. This is illustrated by the fact that the coefficient on land endowment is negative and highly significant; in line with the negative, though insignificant, coefficient on initial per capita expenditure. At the same time, the positive coefficient on possession of draft animals, together with the marginally significant on agricultural assets (at 10%) point towards some imperfections in markets for animals and capital equipment. However, noting that the coefficient on total (non-land) assets is insignificant allows us to conclude that rental markets have a positive overall impact on equity. This is reinforced by the fact that the regression leads us to reject the hypothesis that female-headed households were disadvantaged in access to land rental opportunities and that those who experienced a shock were not more likely to engage in land rental activity.

We also note that rental markets tend to transfer land to producers in the most productive age; the tendency to rent in land increases, though only weakly, up to a maximum of 48 years. Households with access to remittances are slightly less likely to rent in land, although the coefficient is significant only at 10%. Village level variables illustrate that higher security of tenure in the form of land use certificates is highly significant in increasing the demand for renting in. Having all the land in the village under long-term use rights is estimated to increase the propensity to rent in land by almost 12 percentage points, thus highlighting the need for a minimum level of tenure security as one of the institutional pre-conditions for rental markets to emerge. However, rental activity is higher rather than lower in villages that depend more heavily on agriculture, as proxied by the mean share of income from agriculture.

As descriptive statistics pointed towards marked differences across regions, we specify a second model where the level of ability is interacted with regional dummies. Results, reported in column 2 of table 3, confirm that there are significant differences in the extent to which rental markets contribute to greater productive efficiency; point estimates for the respective parameter are 0.15 and 0.14 in regions 1 and 3, respectively, while being much smaller (0.03) in region 2 and insignificant in region 4. Other coefficients are not affected. We note that the general conclusions are consistent with evidence from the tobit model which is available upon request, and will return to discuss the regionally differentiated result for below, jointly with the evidence for sales markets.

On the supply side to the rental market, we find that the sign on ability is insignificant and the sign on land endowments negative and significant at the 10% level, implying that neither low agricultural ability nor large land endowments provide a strong motivation for households to rent out land. In fact, the positive and significant signs on total assets, past off farm experience, and the share of households with credit access in the village all suggest that opportunities for off-farm employment are the driving force behind supply of land to the rental market, a notion that is supported by the negative and significant sign

of the coefficient on agricultural assets. The significant sign of long-term use rights (at 10%) implies that better definition of land rights increases not only demand for land rental as seen earlier, but also serves to augment supply of land to the market. Regional disaggregation of the efficiency parameter supports the conclusion that low efficiency is not a major reason for households to supply land to the rental market while confirming that greater involvement in off-farm activities, smaller household size, and better access to credit at the village level, increase supply of land to rental markets. .

4.2. Land sales markets

Regression results for households' participation in land sales markets, parallel to the evidence for rental, are reported in table 4. We note that it is more productive producers who have, during the last 5 years, been able to acquire land through land purchase. This, together with the fact that larger households with more limited initial land endowments have been able to access such markets, similar to what was observed in rental markets, suggests that, in the case of Vietnam, credit market imperfections have not been strong enough to overcome efficiency advantages.[10]

This does not imply that credit markets would be irrelevant; to the contrary, the fact that the initial endowment with assets, but not the level of agricultural assets, is highly significant, suggests that credit market imperfections affect demand for land through sales but not through rental markets. Interestingly, the share of households with access to credit in the village is highly significant as well, lending further support to the hypothesis that activity in land sales markets will be more pronounced if credit markets function well.

A further parallel to the land rental markets is the high significance of well-defined land rights (i.e. long-term use contracts) as a determinant of land sales market activity. Regional disaggregation, on the other hand, suggests that more efficient producers access land through rental and sales markets only in the Northern Uplands while sales markets are the mechanism of choice in the South and rental markets in the Central Coast. While the longer history of private land rights in the South may be one reason for households preferring sales rather than rental markets to adjust, further study of this issue would be of interest.

As one of the principal concerns against land sales markets is that unfettered operation of such markets would lead poor and marginal producers to part with their land, results from the land supply equation are of particular interest. Contrary to our expectations, the regressions (columns 3 and 4 of table 4) suggest that less productive producers with high levels of endowment and lower levels of agricultural assets tend to sell their land. In fact, the positive and significant coefficient on initial per capita expenditure and the

[10] This conclusion is supported by the fact that the magnitude of the coefficients for sales is not significantly different from those in rental markets.

lack of significance of asset endowments and other wealth-indicators suggests that land sales are not concentrated among the poor.

At the same time, the fact that the coefficient on the shock variable is positive and significant does suggest that households who are affected by an unexpected shock in the form of death of a member may have to resort to selling land as an adjustment strategy. In the augmented model, the interaction between having experienced a shock and credit access at the village level is negative, suggesting that better access to credit allows those hit by a shock to use credit markets, rather than land sales, to smooth consumption. While more detailed investigation of the impact of deaths on households' survival strategies as well as the coping strategies open to them, would be desirable, our results support the hypothesis that, unless households have mechanisms other than land sales, in particular credit markets, to cope with shocks, one can not exclude the scope for land sales markets to lead to undesirable outcomes.

5. Conclusion and policy implications

Our study was motivated by the fact that, even though many transition countries have taken far-reaching measures to establish individual land rights, explicit or implicit restrictions on the functioning of land markets remain widespread. Such restrictions are often motivated by fears that unmitigated operation of land markets may negatively affect equity and possibly efficiency even though the applicable evidence originates mainly from non-transition countries with considerably different structural characteristics. The empirical analysis for Vietnam, which builds on a framework where ability, the level of local non-farm development, and secure land rights and other public goods drive the operation of land rental and sales and rental markets, allows us to contribute to the literature in three respects:

First, we find that both rental and sales markets have an unambiguously positive impact on productivity and provide opportunities for households with higher levels of ability to access land. Together with evidence that these markets have allowed producers with smaller (initial) endowments to gain access to more land, this suggests that, in Vietnam, barriers preventing access to land markets are low. A relatively egalitarian land ownership distribution and rapid growth of off-farm opportunities are likely to partly underlie this result.

Second, we find that non-agricultural development is indeed a major factor in the development of land rental markets. Off-farm employment is not only a key reason for households to supply land to rental markets; the increase in such opportunities during the last 5 years can also go a long way towards explaining the observed surge in rental activity (from less than 4% in 1993 to almost 16% in 1998). We find no evidence to support the hypothesis that credit market imperfections would lead poor but efficient producers to part with their land; to the contrary it is larger land owners with lower levels of agricultural productivity who are offering land on the sales market. At the same time, the fact that households who

recently experienced a shock are more likely to sell land, especially in environments where credit access is limited, implies that, unless other mechanisms for consumption smoothing are available, there remains a danger of distress sales that needs to be accounted for if designing policy interventions.

Finally, government policy has an important impact on land market operation in at least two respects. On the one hand, a variable that is consistently significant in all regressions of market participation is the security of property rights. This supports the hypothesis that provision of clear, enforceable, and secure long-term land rights, even if they may fall far short of full ownership rights, is an essential pre-condition for the operation of land rental and sales markets. On the other hand, access to credit is important to prevent distress sales by households who, without such access, would be unable to smooth consumption in the face of adverse shocks.

These findings are likely to be of relevance for other transition economies as well as for the study of the functioning of land markets in more general terms. Regarding the first, the example of Vietnam illustrates that, in transition economies where, because initial land endowments were distributed in an egalitarian fashion irrespective of individual ability, the scope for increasing allocative efficiency and household welfare through adjustments in operational holding sizes is likely to be large. At the same time, evidence from Eastern European transition countries suggests that failure to clarify land rights or to make households aware of their rights and enable them to enforce such rights at low cost has, in an environment characterized by the asymmetric access to information, capital, and legal means of enforcement that is often typical of transition economies, led to land re-concentration with undesirable social and economic consequences (Csaki *et al.* 2002). While this suggests that "premature" introduction of markets in a context where land rights are not well-defined or can not be enforced can have negative consequences, the example of Vietnam highlights that it is not the functioning of markets *per se* but rather the broader conditions under which such markets operate which can give rise to undesirable outcomes. More research on the necessary pre-conditions, in terms of land rights and the development of other markets, for efficiency-enhancing land transfers to take place and the differential roles performed by land rental and land sales markets in the context of transition economies could improve understanding and the ability to provide policy advice on this issue.

For the study of land markets in general, our findings imply that restrictions on the functioning of land rental which continue to remain in place in a number of countries are difficult to justify. Given that they may be difficult to enforce and associated with considerable losses in terms of efficiency as well as equity, it may be more desirable for policy to try and harness potential of markets through interventions that improve the framework for markets to operation. At the same time, the fact that absence of mechanisms for consumption smoothing may, in the presence of shocks, lead to distress sales with possibly undesirable consequences, suggests that more in-depth evidence on the interactions between land

and credit markets and the long-term impact of land rental as compared to sales markets on (agricultural and non-agricultural) investment, household welfare, and productivity in settings with multiple market imperfections will be of interest. Transition economies such as Vietnam, which, in addition to large inter-regional variation, are also characterized by significant dynamics in land markets, could provide empirical evidence for such research which, by including an assessment of interactions between land markets and non-agricultural investments, could generate insights on the role and contribution of land markets in the broader context of rural economic development.

Table 1. Household Charateristics

	Sample 1993	Sample 1998	N Uplands	Red River Delta & North Center	Coastal Central	Southeast & Mekong Delta
Basic household characteristics						
Size of household	5.12	4.86	5.23	4.42	5.04	5.34
Members younger than 14 years	2.00	1.64	1.97	1.51	1.69	1.62
Member 14-60 years old	2.74	2.78	2.87	2.48	2.91	3.25
Members older than 60	0.38	0.43	0.39	0.43	0.45	0.47
Age of head	44.51	47.32	43.53	47.20	50.16	49.44
Education of head (years)	4.03	6.84	7.28	8.10	5.27	4.73
Female headed	20%	21%	17%	22%	30%	21%
Lost one or more adult members		10.1%	9.8%	8.3%	14.4%	12.1%
Income and its composition						
Per capita expenditure (Mn Dong) 1993	1.69		1.39	1.61	1.80	2.08
Per capita expenditure (Mn Dong) 1998		2.26	1.77	2.29	2.28	2.58
Gini of per capita expenditure	0.263	0.258	0.234	0.251	0.244	0.256
Per capita income (Mn. Dong)	1.25	2.30	2.03	2.01	2.01	3.23
Share of income from agriculture	83%	78%	87%	75%	77%	77%
Share of income from crop production	70%	66%	70%	62%	62%	70%
Head with off-farm job experience	8%	12%	9%	14%	14%	8%
Head with migration experience 1993	11%		11%	11%	14%	9%
Head with migration experience 1998		15%	13%	16%	18%	15%
Family with off-farm job experience	30%	55%	59%	48%	57%	64%
Family with migration experience 1993	29%		25%	23%	37%	43%
Family with migration experience 1998		64%	66%	56%	67%	75%
Share of remittances in income	2%	4%	2%	6%	5%	3%
Land endowment						
Area of annual land (m^2)	2983.16	4320.35	3801.10	2635.07	3522.40	8527.96
Area of perennial land (m^2)	600.24	780.28	548.95	212.31	475.06	2261.79
Land with long term title 1993	25%		20%	9%	14%	65%
Land with long term title 1998		88%	91%	84%	97%	91%
Share of landless	4%	2%	0%	3%	0%	2%
Gini of the per capita land distribution	0.534	0.499	0.343	0.373	0.376	0.515
Asset endowments						
Value of total assets (Mn. Dong)	10.63	30.35	25.23	31.27	24.73	35.33
Share of house	76%	77%	79%	81%	63%	72%
Share of enterprise assets (agric. & industry)	9%	8%	7%	6%	13%	9%
Households w formal credit access 1993	9%		8%	10%	13%	8%
Households w formal credit access 1998		21%	10%	17%	35%	33%
Observations	2825	2825	546	1326	298	655

Source: Own computation from 1998 VLSS

[a] The average exchange rate between US dollar and Vietnamese Dong in 1997/1998 is US$ 1 = 13091 Vietnamese Dong

Table 2: Land market participation in 1993 and 1998

	Total Sample	N Uplands	Red River Delta & North Central	Coast Central	Southest & Mekong Delta
			1993		
Rented in land	3.80%	7.20%	2.60%	1.30%	4.80%
Fixed rent	1.70%	2.40%	1.10%	0.30%	2.90%
Share cropping	0.40%	0.20%	0.50%	0.00%	0.80%
Free	1.70%	4.60%	1.00%	1.00%	1.10%
Bought land	1.00%	0.70%	0.50%	0.00%	2.90%
Rented out land	0.53%	0.20%	0.60%	0.30%	0.80%
Fixed rent	0.20%	0.20%	0.20%	0.00%	0.30%
Share cropping	0.03%	0.00%	0.00%	0.00%	0.20%
Free	0.30%	0.00%	0.40%	0.30%	0.30%
Sold land	0.30%	0.40%	0.00%	0.00%	1.10%
			1998		
Rented in land	15.80%	11.00%	22.70%	8.00%	9.40%
Fixed rent	6.20%	2.20%	7.90%	6.40%	6.10%
Share cropping	2.40%	2.00%	3.70%	0.30%	0.90%
Free	7.20%	6.80%	11.10%	1.30%	2.40%
Bought land	7.20%	9.50%	6.10%	0.70%	10.50%
Rented out land	4.10%	2.00%	5.30%	5.00%	3.70%
Fixed rent	1.20%	0.20%	1.40%	1.00%	2.10%
Share cropping	0.60%	0.20%	1.10%	0.00%	0.20%
Free	2.30%	1.60%	2.80%	4.00%	1.40%
Sold land	1.70%	2.00%	0.20%	0.00%	5.00%
Observations	2825	546	1326	298	655

Table 3. Probit Results for Land Rental Market Participation

	Renting in		Renting out	
	Basic Model	Augmented Model	Basic Model	Augmented Model
Agricultural ability	0.039***		0.003	
	(3.56)		(0.45)	
Agriculutral ability*Region1		0.142***		0.051*
		(3.22)		(1.77)
Agriculutral ability*Region2		0.034**		-0.017*
		(2.32)		(1.66)
Agriculutral ability*Region3		0.153***		0.037**
		(3.64)		(2.22)
Agriculutral ability*Region4		0.002		0.012
		(0.13)		(1.07)
P.c. land endowment (log)	-0.010***	-0.010***	-0.003*	-0.003*
	(4.30)	(4.45)	(1.75)	(1.69)
Value of agricultural assets	0.004*	0.004**	-0.003**	-0.003***
	(1.83)	(2.06)	(2.57)	(2.73)
Value of total assets	-0.001	-0.002	0.003**	0.003**
	(0.47)	(0.83)	(2.15)	(2.01)
Draft animal	0.022**	0.022**	-0.011	-0.010
	(2.18)	(2.43)	(1.62)	(1.51)
P. c. expenditure 1993 (log)	-0.009	-0.011	0.002	0.000
	(1.09)	(1.44)	(0.23)	(0.06)
Log of household size	-0.003	-0.003	-0.017**	-0.016**
	(0.30)	(0.31)	(2.31)	(2.25)
Head's age (log)	1.010**	0.947***	-0.128	-0.103
	(2.51)	(2.60)	(0.50)	(0.43)
Head's age squared	-0.135**	-0.126***	0.019	0.016
	(2.56)	(2.65)	(0.57)	(0.50)
Head's education (log)	-0.029	-0.030	-0.016	-0.015
	(0.98)	(1.12)	(0.75)	(0.75)
Head's education squared	0.015	0.015	0.014	0.015
	(0.88)	(0.98)	(1.24)	(1.34)
Head with off-farm job	-0.004	-0.005	0.031***	0.029***
experience	(0.35)	(0.45)	(2.92)	(2.90)
Head with past migration	0.012	0.013	-0.008	-0.006
experience	(0.92)	(1.06)	(0.90)	(0.74)
Female headed	0.007	0.008	0.003	0.003
	(0.69)	(0.78)	(0.34)	(0.38)
Remittances received (log)	-0.003*	-0.002*	0.002*	0.002*
	(1.78)	(1.75)	(1.71)	(1.73)
Households in village with	-0.005	-0.006	0.029**	0.026**
credit access	(0.25)	(0.34)	(2.19)	(2.01)
Village land w. long term use	0.118***	0.104***	0.035*	0.034*
rights	(3.73)	(3.67)	(1.67)	(1.68)
Temporary migration dummy	-0.013	-0.009	-0.012	-0.011
(village)	(0.83)	(0.61)	(1.36)	(1.34)
Main income from agriculture	0.048***	0.042***	-0.005	-0.005
(village)	(3.26)	(3.13)	(0.37)	(0.39)
Household experienced shock	-0.005	-0.004	0.003	0.003
	(0.42)	(0.34)	(0.34)	(0.30)
Observations	2824	2824	2824	2824
Log likelihood				

Robust z statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%

Table 4. Probit Results for Land Sale Market Participation

	Land Purchases		Land Sales	
	Basic Model	Augmented Model	Basic Model	Augmented Model
Agricultural ability	0.039***		-0.004**	
	(3.67)		(2.34)	
Agriculutral ability*Region1		0.094***		0.006
		(3.30)		(0.94)
Agriculutral ability*Region2		0.024		-0.006***
		(1.24)		(2.74)
Agriculutral ability*Region3		0.015		0.001
		(0.66)		(0.65)
Agriculutral ability*Region4		0.041**		-0.006***
		(2.20)		(2.87)
P. c. land endowment in 1993 (log)	-0.009***	-0.010***	0.005***	0.005***
	(4.22)	(4.42)	(5.30)	(5.73)
Value of agricultural assets in 1993	-0.000	0.001	-0.001*	-0.001*
	(0.26)	(0.74)	(1.86)	(1.88)
Value of total assets in 1993	0.004**	0.005***	0.000	0.000
	(2.24)	(2.62)	(0.78)	(0.74)
Draft animal in 1993	-0.002	-0.012	-0.006***	-0.005***
	(0.26)	(1.24)	(3.19)	(3.34)
P. c. expenditure in 1993	0.005	0.008	0.003**	0.002*
	(0.56)	(0.78)	(2.38)	(1.89)
Log of initial household size	0.027**	0.032**	-0.001	-0.001
	(2.39)	(2.56)	(0.25)	(0.46)
Log of age of household head	0.144	0.224	0.061	0.057
	(0.41)	(0.57)	(1.03)	(1.15)
Log of head's age squared	-0.021	-0.032	-0.009	-0.008
	(0.45)	(0.63)	(1.13)	(1.26)
Log of head's education	0.054	0.058	-0.001	-0.001
	(1.50)	(1.44)	(0.20)	(0.16)
Log of head's education squared	-0.019	-0.023	0.001	0.001
	(1.02)	(1.12)	(0.25)	(0.24)
Head with off-farm job experience	-0.007	-0.013	-0.003	-0.002
	(0.64)	(1.10)	(1.29)	(1.36)
Head with past migration experience	0.008	0.008	0.002	0.001
	(0.62)	(0.58)	(0.67)	(0.57)
Household headed by female	-0.019*	-0.023**	0.000	0.000
	(1.86)	(2.07)	(0.18)	(0.21)
Log of remittances received	-0.002	-0.003*	-0.000	-0.000
	(1.53)	(1.74)	(1.09)	(1.20)
Share of households in village with credit access	0.054***	0.058***	-0.002	-0.002
	(3.53)	(3.21)	(0.61)	(0.79)
Share of land in village titled with long term use	0.049***	0.050**	0.022*	0.021*
	(2.64)	(2.38)	(1.96)	(1.87)
Dummy of village with common temporarily migration	0.010	0.013	0.003	0.003
	(0.87)	(0.99)	(1.27)	(1.39)
Dummy of village with main income from agriculture	0.042**	0.049***		
	(2.38)	(2.59)		
Dummy of households with adult family members die	0.006	0.006	0.008**	0.007**
	(0.50)	(0.45)	(2.17)	(2.28)
Interaction of shock and credit access			-0.019	-0.018*
			(1.39)	(1.71)
Observations	2824	2824	2824	2824
Log likelihood				

Robust z statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%

Appendix Table 1. Fixed Effect Panel Estimation of Crop Production Function

	Household fixed Effect (1)	Household Fixed Effect (2)	Village Fixed Effect (1)	Village Fixed Effect (2)
Log of total seed application	0.018***	0.018***	0.012***	0.013***
	(4.43)	(4.41)	(4.00)	(4.17)
Log of total pesticide use	0.004**	0.004**	0.005***	0.005***
	(2.11)	(2.20)	(2.78)	(2.76)
Log of total organic manure use	0.011***	0.011***	0.014***	0.014***
	(5.75)	(5.75)	(9.86)	(9.76)
Log of total fertilizer use	0.025***	0.025***	0.028***	0.028***
	(6.94)	(6.86)	(10.40)	(10.51)
Log of total crop area	0.722***	0.722***	0.763***	0.757***
	(52.09)	(52.12)	(80.89)	(79.78)
Log of household head's age	0.059	0.040	0.016	-0.006
	(1.33)	(0.94)	(0.73)	(0.32)
Log of household size		0.001		0.093***
		(0.05)		(6.74)
Log of no. of household member with age less than 14	0.001		0.004**	
	(0.40)		(2.39)	
Log of no. of household member with age between 14 and 60	0.001		0.012***	
	(0.12)		(3.77)	
Log of no. of household member with age greater than 60	-0.006**		0.001	
	(2.08)		(0.48)	
Log of total agricultural assets	0.004***	0.003***	0.010***	0.009***
	(2.74)	(2.63)	(10.10)	(9.73)
Share of irrigated area in total crop area	0.096***	0.096***	0.039**	0.039**
	(4.40)	(4.36)	(2.02)	(2.05)
Dummy of draft animal	0.037	0.038	0.050***	0.046***
	(1.53)	(1.58)	(3.36)	(3.06)
Year==98	0.358***	0.358***	0.365***	0.364***
	(30.60)	(30.56)	(31.39)	(31.40)
Observations	6160	6160	6160	6160
R-squared	0.68	0.68	0.77	0.77

Robust z statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%

Appendix: Derivation of propositions

Proposition 1. The amount of land rented in is strictly increasing in ability, α, and strictly decreasing in their land endowment $\overline{A}$. Rental markets will thus transfer land to "poor but efficient" producers.

Total differentiating both sides of (1) with respect to α (again, *i* is ignored for notation simplicity), yields:

$$pf_{l^a}(l^a, A) + p\alpha(f_{l^a l^a}\frac{\partial l^a}{\partial \alpha} + f_{l^a A}\frac{\partial A}{\partial \alpha}) = 0 \qquad \text{(A1)}$$

Total differentiation of both sides of (2) or (2)' with respect to α, yields:

$$pf_A(l^a, A) + p\alpha(f_{AA}\frac{\partial A}{\partial \alpha} + f_{Al^a}\frac{\partial l^a}{\partial \alpha}) = 0 \qquad \text{(A2)}$$

Putting (A1) and (A2) in matrix form yields:

$$\begin{bmatrix} p\alpha f_{l^a l^a} & p\alpha f_{l^a A} \\ p\alpha f_{Al^a} & p\alpha f_{AA} \end{bmatrix}\begin{bmatrix} \partial l^a / \partial \alpha \\ \partial A / \partial \alpha \end{bmatrix} = \begin{bmatrix} -pf_{l^a} \\ -pf_A \end{bmatrix}$$

Solving for $\partial A / \partial \alpha$ by Cramer's rule, yield:

$$\partial A / \partial \alpha = \frac{\begin{vmatrix} p\alpha f_{l^a l^a} & -pf_{l^a} \\ p\alpha f_{Al^a} & -pf_A \end{vmatrix}}{|H|} = \frac{-p^2\alpha f_A f_{l^a l^a} + p^2\alpha f_{Al^a} f_{l^a}}{|H|} > 0 \qquad \text{(A3)}$$ (for $f_A > 0$, $f_{l^a} > 0$, $f_{l^a l^a} < 0$,

and we know $|H|>0$ by the sufficient second order condition of maximization problem.)

This implies that for all households that participate in rental markets (on either side), the amount of area operated will increase with ability.

For households renting in, the amount of land rented in is the difference between the amount of operational land and the land endowment, i.e. $A_{in} = A - \overline{A}$ (A4).

Total differentiation of both sides of (A4) with respect to α, yields $\frac{\partial A_{in}}{\partial \alpha} = \frac{\partial A}{\partial \alpha} > 0$, implying that for households who rent in land, the amount of land rented in is increasing in agricultural ability. Total differentiation of both sides of (A4) with respect to $\overline{A}$, yield $\frac{\partial A_{in}}{\partial \overline{A}} = -1 < 0$, implying that for the households who rent in land, the amount of land rented in is strictly decreasing in land endowment.

For those households that rent out land, the amount of land rented out is the difference between the land endowment and the land used for self-cultivation, or formally, $A_{out} = \overline{A} - A$ (A5).

Total differentiation of both sides of (A5) with respect to α, yields $\frac{\partial A_{out}}{\partial \alpha} = -\frac{\partial A}{\partial \alpha} < 0$, which implies that for those households who rent out land, the amount of land rented out will decrease in agricultural ability. Total differentiation of both sides of (A5) with respect to $\bar{A}$, yields $\frac{\partial A_{out}}{\partial \bar{A}} = 1 > 0$, implying that for those households who rent out land, the amount rented out is strictly increasing in land endowment.

Proposition 2. Presence of transaction costs drives a wedge between those renting in and those renting out with any increase in T decreasing α_l and increasing α_u, thereby expanding the range of producers who remain in autarky, reducing the number of households who participate in rental markets, as well as the amount of land transacted through rental markets.

Totally differentiating both sides of equation (1) and (2) with respect to T, yields

$$p\alpha f_{l^a l^a}\frac{\partial l^a}{\partial T} + p\alpha f_{l^a A}\frac{\partial A}{\partial T} = 0$$

$$\text{and } p\alpha f_{Al^a}\frac{\partial l^a}{\partial T} + p\alpha f_{AA}\frac{\partial A}{\partial T} = -1$$

We obtain $\partial l^a / \partial T$ from the first equation and substitute into the second equation, which yields

$$\frac{\partial A}{\partial T} = \frac{-1}{p\alpha[f_{AA}f_{l^a l^a} - (f_{Al^a})^2]} < 0 \qquad \text{(A6)}$$

Equation (A6) implies that households who rent in will operate less land as the transaction cost increases.

Total differentiation of both sides of (A4) with respect to T yields $\frac{\partial A_{in}}{\partial T} = \frac{\partial A}{\partial T} < 0$, implying that households who still rent in land will rent in less and as the transaction cost increases.

Totally differentiating both sides of equation (1) and (2)' with respect to T and rearranging terms yields:

$$\frac{\partial A}{\partial T} = \frac{1}{p\alpha[f_{AA}f_{l^a l^a} - (f_{Al^a})^2]} > 0 \qquad \text{(A7)}$$

Equation (A7) implies that households in the renting in pool will operate less land as the transaction cost increases. Total differentiate both sides of (A5) with respect to T, yield $\frac{\partial A_{out}}{\partial T} = -\frac{\partial A}{\partial T} < 0$, implies that households who still rent out land will rent out less as the transaction cost increases.

For households who continue to rent in, the optimal operational land holding can be obtained from equation (1) and (2) as $A_i = A_i(\alpha, p, r, T, w)$. Setting A_i to $\overline{A}_i$, yields the identity

$$\overline{A}_i = A_i(a_i, p, r, T, w) \qquad \text{(A8)}$$

Totally differentiating both sides, yields, $d\overline{A}_i = \frac{\partial A_i}{\partial \alpha_i} d\alpha_i + \frac{\partial A_i}{\partial T} dT = 0$ (for $d\overline{A}_i = 0$)

$$\frac{d\alpha_u}{dT} = -\frac{\frac{\partial A_i}{\partial T}}{\frac{\partial A_i}{\partial \alpha}} > 0 \qquad \text{(A9)} \qquad \text{(for } \frac{\partial A_i}{\partial \alpha} > 0 \text{ from (A3) and } \frac{\partial A_i}{\partial T} < 0 \text{ from (A6)),}$$

implying

that as the transaction costs increase more households would change from renting in land to autarky.

Similarly for the households who continue to rent out land, and based on (1) and (2)', we can derive the following proposition:

$$\frac{d\alpha_l}{dT} = -\frac{\frac{\partial A_i}{\partial T}}{\frac{\partial A_i}{\partial \alpha}} < 0 \qquad \text{(A10)} \quad \text{(for } \frac{\partial A_i}{\partial \alpha} > 0 \text{ from (A3) and } \frac{\partial A_i}{\partial T} > 0 \text{ from (A7)),}$$

implying

that, as transaction costs increase, more households would change from renting out to autarky.

Proposition 3. Increases of the exogenously given wage for off-farm employment will increase the amount of land transacted in rental markets by increasing the amount rented out by households with low agricultural ability (who join the off-farm labor force) and the amount rented in by those with high-ability (who specialize in agricultural production). This will be associated with a decrease in the equilibrium rental rate which, in a risk-free environment, will make everybody better off.

Without loss of generality, we assume that only the households who originally rented land out will take advantage of the increased off-farm opportunities. Those who rented in land originally will continue to rent in land and the their off-farm opportunities are assumed to remain the same as before. In other words, households who rented out land before will face wage increase while those who rented in land before will face the same wage with the increase of the overall off-farm opportunities.

For those households who rented out land, we take the derivative of both sides of equation (1) or equation (2)' with respect to w, yield

$$p\alpha f_{l^a l^a}\frac{\partial l^a}{\partial w}+p\alpha f_{l^a A}\frac{\partial A}{\partial w}=1$$

$$p\alpha f_{Al^a}\frac{\partial l^a}{\partial w}+p\alpha f_{AA}\frac{\partial A}{\partial w}=0$$

Obtain $\partial l^a/\partial w$ from the second equation and substitute into the first equation, we will have

$$\frac{\partial A}{\partial w}=\frac{f_{Al^a}}{p\alpha[(f_{Al^a})^2-f_{l^a l^a}f_{AA}]}<0 \qquad \text{(A11)}$$

which implies that households who rented out land will use even less endowment for self-cultivation and $A_{out}=\overline{A}-A \Rightarrow \frac{\partial A_{out}}{\partial w}=-\frac{\partial A}{\partial w}>0$, implying that amount of land rented out by individual household is increasing in its off-farm opportunity, as consequence, aggregate supply of land increases.

If we also assume that off-farm opportunities will not affect those households who originally rented in, greater supply of land due to increases in the wage rate will lead to a decrease in rental rate. To show this informally, let $a_{in}=a_{in}(\alpha_1,...\alpha_I,p,w^{in},r^*,T)$ be the aggregate rent-in curve, and let $a_{out}=a_{out}(\alpha_1,...a_I,p,w^{out},r^*,T)$ be the aggregate rent-out curve. At equilibrium, set amount of land rented in equals to the amount of land rented out, or

$$a_{in}(\alpha_1,...\alpha_I,p,w^{in},r^*,T)=a_{out}(\alpha_1,...\alpha_I,p,w^{out},r^*,T) \qquad \text{(A12)}$$

Total differentiate both sides of (A11) by allowing r^* and w^{out} to vary, yield:

$\frac{\partial a_{in}}{\partial r^*}dr^*=\frac{\partial a_{out}}{\partial r^*}dr^*+\frac{\partial a_{out}}{\partial w^{out}}dw^{out}$, rearrange terms, we will have $\frac{dr^*}{dw^{out}}=\frac{\frac{\partial a_{out}}{\partial w}}{\frac{\partial a_{in}}{\partial r^*}-\frac{\partial a_{out}}{\partial r^*}}$ (A13)

It is easy to show that the sign of (A13) is negative. We know $\frac{\partial A_{out}}{\partial w}>0 \Rightarrow \frac{\partial a_{out}}{\partial w}>0$, $\frac{\partial a_{in}}{\partial r^*}<0$, and $\frac{\partial a_{out}}{\partial r^*}>0$; we just showed that the equilibrium rental rate falls as the off-farm opportunities increases.

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